A Longitudinal Study of Disease Incidence Among Antarctic Winter-Over Personnel

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A longitudinal perspective was employed to test the hypothesis that there is an increased risk of hospitalization among Antarctic winter-over personnel during the first year subsequent to this duty. Subjects were 327 enlisted Navy men who wintered-over between 1963 and 1974 and a control group of 2,396 enlisted men who volunteered and were accepted for winter-over duty but who did not winter-over. A 15-year period from 1965 to 1979 was established for follow-up. Follow-up of subjects subsequent to screening for Operation Deep Freeze was conducted in 6-month intervals for the first 4 years. Results indicated that the total rates of first hospitalization during the 6 months prior to Antarctic duty and the first 6 months in Antarctica among winter-over personnel were significantly lower than the rates for the control group. No significant difference in the rates of the two groups was observed for the 12 months subsequent to winter-over duty.

A PREVIOUS STUDY of long-term disease incidence among U.S. Navy personnel who have wintered-over in small, isolated Antarctic research stations found that over a 15-year study period, these personnel have significantly lower total first hospitalization rates than a control group of enlisted personnel who were positively evaluated for Antarctic duty but who did not winter-over (12). When individual diagnostic categories were examined, the winter-over group had significantly fewer first hospitalizations for neoplasms; endocrine, nutritional, and metabolic diseases; and diseases of the musculoskeletal system. Physiological changes which occur during the Antarctic winter and demographic, personality, and socioenvironmental factors which mediate the physical and psychological stress associated with prolonged isolation in an extreme environment were suggested as partial explanations for the lowered risk.

However, it has been observed that winter-over personnel are at risk for disease and psychological stress upon their return to the outside world. Outbreaks of common colds have been noted among personnel at many isolated antarctic stations immediately following the end of the isolation period and the resumption of contact with the outside world (1,7–9). Although the evidence for an increased risk is not conclusive (6), the relative absence of viruses in the Antarctic and the lower resistance associated with neutropenia (14) may result in a reduction in immunocompetence, leaving the individual exposed to the risk of diseases of the respiratory system and infective and parasitic diseases. A study by Oliver (11) also found that adjustment problems and "culture shock" to home and new surroundings were common for returning winter-over personnel, and Natani and Shurley (10) observed that the process of readjustment to the larger society was potentially very stressful for winter-over personnel.

While the earlier follow-up study indicated that the winter-over experience has no long-term effects on the health and performance of enlisted Navy personnel, the possibility of a short-term risk immediately following the end of winter-over duty was not adequately addressed. Incidence rates for the follow-up period were averaged for the entire 15-year period and included time spent in the study immediately prior to and during the winter-over period. This study attempted to expand on the results of the first study by examining disease incidence of enlisted Navy winter-over personnel across time. A longitudinal perspective was employed to test the hypothesis that even though there may be no long-term health risk, winter-over personnel are at in-

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creased risk for hospitalization during the first year subsequent to winter-over duty.

MATERIALS AND METHODS

Military and civilian applicants are evaluated for Antarctic winter-over duty by teams of psychiatrists and clinical psychologists through the Operation Deep Freeze Program. Records of screening evaluations conducted between 1963 and 1974 were compiled into a computerized file at the Naval Health Research Center. This file was then matched with the Inpatient Medical Data File at NHRC and service history data files obtained from the Manpower and Personnel Management Information System (NMPC 15642) to obtain follow-up data on all enlisted personnel who participated in the Operation Deep Freeze Program during these years. Civilian applicants were not included because of the lack of available follow-up data. Follow-up information was obtained on 3,076 individuals on the basis of matching social security or service numbers.

For this study, cases were defined as those who wintered over at one of a number of small scientific stations between 1963 and 1974. A control group was comprised of individuals who applied for winter-over duty during the same period and were given a favorable combined evaluation by the screening team but who did not winter-over. Some of the program participants who were given unfavorable evaluations but who subsequently did winter-over were excluded from the study in order to reduce the potential confounding effects of personality variables. Of the 3,076 enlisted Navy personnel on whom follow-up information was available, 327 were identified as having wintered over and not having a negative combined evaluation by the psychiatrist/psychologist screening team. The control group was comprised of 2,396 enlisted Navy men who were screened during the study period and were considered to be acceptable by the screening team but who nevertheless did not winter-over. The demographic characteristics and service histories of these two groups have been described elsewhere (12).

A 15-year period from 1965 to 1979 was established for follow-up. This was based on the period of time for which medical and service history information was available for both groups at the time the study was conducted. The start date for participation in the study was established as 1 January 1965 or the year an individual was evaluated for the Operation Deep Freeze Program if after this date. Withdrawal was defined as the date of last discharge from the Navy or 31 December 1979, whichever came first. Follow-up of subjects subsequent to entry into the study (i.e., subsequent screening for Operation Deep Freeze) was conducted in 6-month intervals for the first 4 years, allowing us to focus specifically on the period immediately prior to, during, and immediately following winter-over duty. Screening of enlisted personnel usually occurs in April of each year. Antarctic duty begins in September at the earliest and usually lasts for one year. This winter-over period usually begins in February and lasts until October.

Inpatient medical data included all first hospitalizations for all diagnoses which occurred during each interval of the 6 year follow-up period. Diagnoses were in accordance with the Eighth Revision, International Classification of Disease Adapted for Use in the United States (ICDA-8). Population at risk was defined as those subjects who remained in the study at the end of each interval.

Age-adjusted rates of total first hospitalizations were calculated for each time interval using the direct method of adjustment (5). The standard population was comprised of all study participants at risk during the time interval. The rates for the winter-over and control groups were compared to obtain estimates of relative risk by taking the ratio of rates for the winter-over group to rates for the control group. Levels of significance of these associations were obtained using 95% confidence intervals (2).

RESULTS

The average rate of total first hospitalizations (incidence) for the 15-year period in the earlier study was significantly lower for the winter-over group, yielding a relative risk of 0.79 (12). Because of the reduced populations in each time interval in the current study, statistical significance was evident only in a few instances. Therefore, only total first hospitalizations are reported here. While some trends were evident in specific disease categories, such as diseases of the respiratory, circulatory, and digestive systems, the number of cases among the winter-over group were too few to achieve statistical significance and hence will not be reported.

The incidence of total first hospitalizations for all diagnoses among cases and controls by 6-month intervals for the first 4 years of study participation is represented in Table I. The rate for the winter-over group during the first

TABLE I. AGE-ADJUSTED RATES OF TOTAL FIRST HOSPITALIZATIONS FOR WINTER-OVER AND CONTROL GROUPS, OPERATION DEEP FREEZE PARTICIPANTS, 1965–1979 BY 6-MONTH INTERVALS (PER 10,000 PERSON-YEARS).

Interval Number	Period (Months)	Mid-point (Months)	Winter-Over		Controls		Relative Risk	95% Confidence Limits
			N	Rate	N	Rate		
1	0–6	3	3	104.7	79	359.0	0.29	−0.04–0.62*
2	6–12	9	4	137.3	65	345.2	0.40	0.00–0.80*
3	12–18	15	9	309.4	81	478.2	0.65	0.20–1.10
4	18–24	21	12	444.5	82	518.5	0.86	0.34–1.38
5	24–30	27	14	577.3	59	403.0	1.43	0.60–2.26
6	30–36	33	7	306.1	55	395.9	0.77	0.16–1.38
7	36–42	39	12	546.3	72	548.0	1.00	0.39–1.61
8	42–48	45	9	420.0	59	610.5	0.69	0.21–1.17
6–30	30–180	90	114	577.3	824	703.7	0.82	0.67–0.97*

* $p < 0.05$.

two 6-month periods of study participation was significantly lower than the rate for the control group. The rate for the winter-over group displayed a steady increase, however, reaching a peak during the fifth interval which was about 27 months after entry into the study and 9 months after the end of winter-over duty. With the increase in the rate of total first hospitalizations, the relative risk also increased, reaching a peak at the same time (i.e., 9 months after the winter-over period). This is clearly evident from Figure 1. However, this relative risk of 1.43 was not statistically significant. Moreover, the rate of total first hospitalizations among the winter-over group for the remainder of the study period (months 30 to 180) was significantly less than the rate for the control group.

DISCUSSION

Although both groups may be similarly qualified and given favorable evaluations by the screening team, the winter-over group demonstrated a significantly smaller disease incidence during the 6 months immediately prior to winter-over duty and during the first 6 months of assignment in the Antarctic. The question remains as to why this is the case. One possible explanation is that the significantly lower rates of total first hospitalizations among the winter-over group, particularly during the period immediately prior to Antarctic duty, when compared with the control group, may be indicative of the success of the Operation Deep Freeze Program in selecting the healthiest candidates for winter-over duty. However, both groups were evaluated as acceptable for winter-over duty by the screening team. No significant differences between the two groups were observed on any of the screening personality measures, and differences in age and, indirectly, pay grade and length of service were taken into consideration by the age-adjusted rates. With the exception of differences in education and occupation, the two groups appear to be adequately matched with respect to known health risk factors.

An alternative explanation is that the harshness of the environment combined with the processes of psychosocial adjustment to prolonged isolation minimize the risk of disease both in the short-term and, in the case of adaptation, in the long-term as well. Previous research has attributed the low incidence of infectious diseases and diseases of the respiratory system among Antarctic personnel during the austral winter as the result of prolonged isolation in a relatively sterile and disease-free environment (1,6,8,14). This would help to account for the smaller rates of first hospitalizations during the intervals of Antarctic duty. In addition, despite the presence of the psychological symptoms of the "winter-over syndrome" which appear to affect most winter-over personnel in varying degrees, the microcultures of Antarctic research station support and promote values and personality traits in individual members which enable them to adapt to isolation and which also may promote health on a long-term basis as well (13,15). The significantly lower rate of total first hospitalizations among the winter-over group after the fifth interval (27 months after entry into the study and 9 months after returning from the Antarctic) would appear to suggest such a long-term benefit from this process of adaptation. This process may also begin immediately upon selection for winter-over duty, which would account for the significantly lower rates during

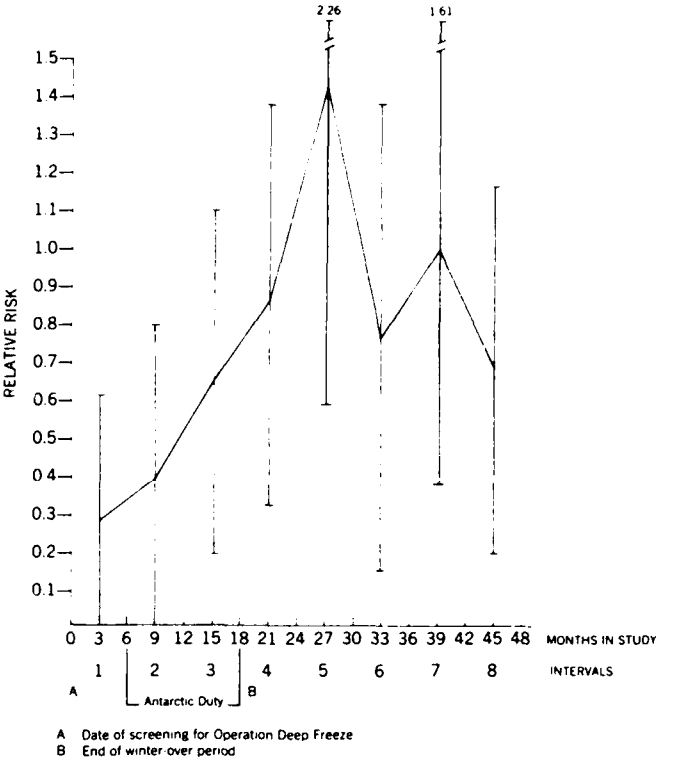

Fig. 1. Relative risk of total first hospitalizations for winter-over group, 1965–1979. First 4 years of study participation by 6-month intervals.

the 6 months prior to Antarctic duty. Hence, the process of psychosocial adjustment may have long-term as well as short-term benefits for one's health and well-being.

During the last 6 months of Antarctic duty and the first 6 months subsequent to returning to the outside world, the relative risk of disease incidence among the winter-over group was no greater than that of the control group (i.e., it remained below 1.0). However, during the second 6 months after returning to the outside world, the relative risk for disease incidence among the winter-over group showed a marked increase, followed by a decline and a second, but smaller increase. These variations were not statistically significant, however, indicating that although winter-over personnel may have a greater rate of total first hospitalizations upon return from Antarctic duty than either prior to or during such duty, this increase does not place them at greater risk for disease incidence relative to other Navy personnel who do not winter-over.

Because of the small number of cases in each interval, especially among the winter-over group, it is difficult to generalize the results of this study. Statistical significance was achieved only in the first two of the 6-month intervals during the first 4 years of study participation. Moreover, while differences in age were taken into consideration when comparing rates of the two groups, other characteristics such as education and occupation which are known to influence hospitalization rates in the Navy (3–4) were not controlled because of the small number of cases.

Nevertheless, the results of this study lend further support to the hypothesis that the winter-over experience is not associated with any long-term risk for disease incidence. While some increase in disease incidence was observed upon

return from winter-over duty, this increase failed to reach statistical significance and, hence, suggested no threat to the health and well-being of winter-over personnel either in the short-term or the long-term. In order to account for these results, two alternative explanations were discussed. However, further investigation is necessary to identify the specific causal factors.

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A longitudinal perspective was employed to test the hypothesis that there is an increased risk of hospitalization among personnel who winter-over in Antarctica during the first year subsequent to the winter-over duty. Subjects were 327 enlisted Navy men who wintered over between 1963 and 1974 and a control group of 2,396 enlisted men who volunteered and were accepted for winter-over duty but who did not winter-over. A fifteen year period from 1965 to 1979 was established for follow-up. Follow-up of subjects subsequent to screening for

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Operation Deep Freeze was conducted in six month intervals for the first four years. Results indicated that the total rate of first hospitalization during the six months prior to Antarctic duty and the first six months in Antarctica was significantly lower than the rate for the control group. The rate for the winter-over group displayed a steady increase, peaking at nine months subsequent to returning from Antarctic duty. This peak rate was not significantly different from the rate of the control group, however. These results lend further support to the hypothesis that the winter-over experience is not associated with any long-term risk of disease incidence.